

CA DEPARTMENT OF COMMUNITY SERVICES & DEVELOPMENT (CSD)
Combustion Appliance Safety Inspection Form
INSTRUCTIONAL SUPPLEMENT (IS)

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“X”—CAS PROCEDURES

X-1 WITHIN 10' OF THE LIVING SPACE (See WIS page 1-3)

1. All applicable CAS checks must be performed on all appliances in the following locations:
 - a. Within the House, Attic, Basement, Utility or Appliance Room, Attached Garage, or Closet accessed from outdoors.
 - b. Outside the house:
 - Roof-mount or Slab-mount FAU. (All Heating Systems are tested, regardless of location).
 - Water Heater, Clothes Dryer, etc. within 10' of a Door or Window leading into the Living Space.
2. Check all gas appliances, even if one fails, or if one cannot be completely tested (see Z-10).
3. See Z-9 regarding abandoned appliances, and see Z-5.2 regarding malfunctioning Cook Top/Oven.

X-2 MORE THAN 10' FROM THE LIVING SPACE (See WIS page 1-2)

1. Checks only for Gas Leaks (see Z-3) are required on appliances in structures detached from the home and located more than 10' from any entry door or window of the home.
2. Gas Leaks must be repaired (see Z-13).
3. Repair of other defects is not required if combustion products will not enter the living space; however, repairs must be recommended to the client and recorded in (D).

X-3 COMMON VENT (See WIS page 1-6)

When two appliances share a Common Vent, operate *both* appliances simultaneously during tests.

- Exception: When CO in either appliance is sampled beyond the common vent Wye (e.g., an Induced Draft Furnace checked at the vent termination), turn off the other appliance during that CO Test.

X-4 APPLIANCE TEST CONDITIONS (See WIS pages 1-6 & 1-7)

This section addresses house set-up for Draft Tests and Flue-Gas CO Tests. (For Ambient CO test conditions, which are *different*, see WIS page 1-5, Conventional Appendix H, and Mobile Appendix E.)

1. Doors and Windows:

- a. **Close** all windows and all **exterior** doors.
- b. **Close** the following **interior** doors:
 - Doors into appliance enclosures and garage (*except* during “open-door” tests).
 - Doors into storage closets/rooms, etc. that do not contain a supply register or exhaust fan.
 - Doors that are closed per CAZ Test results.
- c. **Open** the following **interior** doors:
 - Generally, doors to interior rooms and hallways are **open**.
 - The following exceptions apply:
 - Doors listed in **b.** above are closed.
 - When an FAU is present, doors are closed as instructed in **d.** below.
 - Doors that are otherwise normally open are closed as needed for “closed-door” tests.
- d. Homes with an FAU: **Close** doors separating supply registers from a central return, including:
 - The door to a master bedroom, even when there is a fan in the master bath.
(The bedroom door is closed, but the bathroom door is open with the fan on.)
 - Door from main body of the house into bathroom, utility room, etc. containing an exhaust fan.
(The door is closed, but the fan is on.)

2. Fans and Exhaust Devices

These are devices—vented directly outdoors or vented into an attic or crawlspace—which exhaust air from the building. They are operated during appliance testing, because they may cause depres-

surization that affects the performance of open combustion appliances in the building/space. Fans and exhaust devices to be operated during appliance testing include the following:

- a. Bathroom and Utility Room fans.
- b. Range Hood ducted outdoors.
- c. Clothes Dryer exhausted outdoors.
 - *Note:* Clean the lint filter, make sure the drum is empty, and operate in air-only mode *except* when testing unit for CO.
- d. Central vacuum system.
 - *Note:* If a hose must be “plugged in” to activate the system, use the inlet closest to the combustion appliance zone that would be most greatly affected. First priority is an open combustion appliance vented outdoors and located in the living space (e.g., a water heater in the kitchen). Second priority is an appliance enclosure, whether or not it is vented indoors.
- e. Attic vent fan (if manually controlled).
- f. Exception: Whole House Fans are not operated during CAS testing.

3. FAU Air Handler Fan

- a. In addition to Exhaust Fans/Devices, operate the Air Handler during appliance testing, and select high speed when possible.
 - When there is a Fan control with “Auto” and “On” positions, the “On” position will usually operate the fan at high speed.
 - If there is a fan speed control on the furnace itself, select the highest speed available.
- b. When burner operation is not required, it is preferable to run the fan with the burner off (e.g., when the wall thermostat has separate Furnace and Fan controls, switch the “Heat-Off-Cool” control to Off and the “Fan” control to On).

4. Other Appliances

- a. Operate all other open combustion vented appliances which can affect operation of appliance(s) being tested (e.g., Water Heater in the same enclosure/space with a Furnace).
- b. Exception: Commonly-vented appliances, as prescribed above in X-3.

5. Filters

- a. Exhaust Fans: Clean or remove dirty filters (e.g., greasy Range Hood filter).
- b. FAUs: Make sure air filter is clean or removed during tests.
 - After tests, the filter must be cleaned (if washable) or replaced.
 - Do not leave an FAU with dirty, clogged Filter(s).

X-5 OUTDOOR TEMPERATURE

1. Measure in the shade.
2. Recheck each time Mechanized Draft Tests are conducted.

X-6 WHEN CAS TESTS ARE TO BE PERFORMED

1. Perform CAS “**Pre-Wx Tests**” *prior* to installing any Wx measures (see P&P Sections 1.20-1.22).
2. Perform “**Interim Tests**” to make sure the home is not being left with *Immediate Service Required* (see Z-1) when Shell or Duct Sealing is not completed in one day (see P&P Sections 1.23, 1.24, and 1.29-1.31).
3. Perform CAS “**Post-Wx Tests**” after weatherization when required (see P&P Sections 1.25 & 1.26).
4. If an **Interim Test** or **Post-Wx Test** reveals a condition with *Immediate Service Required*, and if corrections are *not* made before crew leaves the premises, do the following:
 - a. Turn the appliance off at the thermostat.
 - b. Follow Z-1 instructions, and *arrange for corrections within 24 hours* (see P&P Sections 1.27 & 1.28).

X-7 OPEN-DOOR & CLOSED-DOOR TESTS

1. **General:** When possible, CO and Draft Tests must be performed with doors to the room or space containing appliances both open and closed, and the results of both tests are recorded separately.
 - a. When the enclosure is too small for a person to fit into with the door closed, it is OK to do only the "Open Door" Test and circle "N/A" in the "Closed Door" box.
 - b. *Note:* It is sometimes possible to get "Closed Door" readings in a small enclosure by doing the following:
 - Use the Draft Gauge with long tubing and a CO Analyzer probe extension with plastic tubing.
 - Run the tubing under the door and close it if gap is large enough—or close door as much as possible around the hose.
2. **Confined Area/Hallway:** For an appliance in a confined area that can be closed off completely with doors (e.g., Wall Furnace or Floor Furnace in a hallway):
 - a. Do "Closed Door" Test with all doors closed.
 - b. Do "Open Door" Test with door(s) open to a common area (e.g., Kitchen, Living Room).
Note: A wall furnace in a closeable hallway most likely does not have adequate combustion air.
3. **Garage:**
 - a. For all tests:
 - Keep drive-through garage door closed.
 - Keep all Fans and Exhaust Devices in the garage operating, such as:
 - Clothes dryer exhausted outdoors.
 - Air Handler—when the FAU or any part of the return system is located in the garage.
 - b. For "Closed Door" Test, close all doors and windows.
 - c. For "Open Door" Test:
 - Open door into the house (with all Exhaust Devices in the house operating).
 - If there is no door into the house, only "Closed Door" Tests are required.
4. **Attic and Crawl Space:** Perform only "Closed Door" tests, with the access in the normal, closed position.

X-8 DRAFT TEST HOLE LOCATION & SIZE (See WIS page 1-9)

Check Draft on both Natural Draft and Induced Draft units.

1. **Drilling Holes for "Mechanized" (Instrumented) Draft Test:**
 - a. Drill a hole 12" to 24" above the Draft Hood (inducer fan assembly on Induced Draft furnaces).
 - b. Drill hole only in a straight section (avoid elbows and wyes) of rigid Single-Wall metal vent pipe (Double-Wall when allowed).
 - c. Hole diameter should be 1/16" larger than test probe (5/16" is standard hole size for 1/4" probe).
2. **Do not drill:**
 - a. Double-Wall Metal Pipes when prohibited (see WIS page 1-9).
 - b. Flexible Pipes (e.g. ribbed flexible aluminum Water Heater Vent Connectors).
 - c. Pipes containing Asbestos.
3. **Seal holes drilled for Draft Test.**
 - a. After *each* Draft Test, seal the hole with a tight-fitting "Plug Button".
 - b. After Draft is checked for the last time (e.g., Post-Wx Test), Plug Button may be additionally secured with Metallic Tape or High-Temp Caulk (e.g., 450 °F RTV red silicone).
 - c. Seal test hole in a Double-Wall pipe with a tight-fitting Lag Bolt and High-Temp Caulk. Put caulk on the threads as needed to seal the inner hole.

X-9 CO TEST LOCATIONS (See WIS, Section 1, Item 7)**1. Natural Draft Open Combustion Appliances:****a. Furnace or Heater:**

- In the exhaust port(s) inside the Draft Hood. Check *each* Exhaust Port on multi-burner units.
- When there is a baffle present (e.g., in a Wall Furnace), check CO on both sides of the baffle.

b. Water Heater: Inside the Center Tube on both sides of the baffle.**c. Clothes Dryer:**

- Inside Moisture Exhaust termination, or
- If lint screen is accessed from top of dryer, probe may be placed down into lint screen cavity.

d. Gas Log: Inside the top edge of the fireplace opening.**e. Gas Fireplace (Free-Standing or Fireplace Insert):** Place probe extension into dilution air intake and point end down into the Flue (as you would into a Water Heater center tube).**2. Cooking Appliances:****a. Cook Top:**

- Approximately 12" above burner with grate in place.
- Hold probe horizontally—do not point end of probe into the flame.

b. Griddle: Inside the port opening with Griddle in place.**c. Oven or Broiler:**

- Inside Oven Exhaust Termination on the Stove (usually at the back of the stove top).
- Ovens *vented outdoors*: Test ahead of where dilution air is added, or in the Vent Termination outdoors after dilution air vents have been blocked.

3. Induced Draft Open Combustion:**a.** Through Draft Test hole in Vent Pipe (see X-8) when feasible, or**b.** Inside Vent Termination on roof.

Note: When roof climb is not feasible, use 1/4" OD aluminum probe extension (up to 10' long).

4. Closed Combustion: Inside Flue termination (e.g., on a Mobile Home).

Note: When roof climb is not feasible, use 1/4" OD aluminum probe extension (up to 10' long).

5. No Access for Flue-Gas Sample: (Also see Z-10 regarding inaccessibility for testing.)**a.** Check for CO in the nearest Register or above the Heat Exchanger (CASIF step F-4.B).**b.** No-access examples include:

- Roof climb not feasible (e.g., inaccessible or roofing is deteriorated).
- Roof-Mount Furnace is on a tile roof.
- Mobile Home closed combustion flue not accessible due to awnings along both sides of mobile.

“Y”—DRAFT and COMBUSTION AIR REQUIREMENTS**Y-1 MINIMUM DRAFT** (See WIS pages 1-8 & 1-9)

Adequate draft is always indicated by a *negative* pressure. A Draft Gauge is usually calibrated in “inches of water column” (iwc), while a Digital Manometer is read in Pascals (Pa). The amount of negative pressure considered “adequate” is determined by the outdoor temperature. The *minimums* are shown in the following table:

Outdoor Temperature	Minimum Negative Pressure	
Below 30°F	- 0.02 iwc	- 5.0 Pa
30 to 80°F	- 0.01 iwc	- 2.5 Pa
Over 80°F	- 0.005 iwc	- 1.25 Pa

Y-2 COMBUSTION AIR FOR OPEN COMBUSTION APPLIANCES (See WIS pages 1-19, 1-20 & 1-21)**Y-2 (A) OVERVIEW**

- Open-combustion appliances draw combustion air from the room/space in which they are located.
 - The appliances can be “Natural Draft” (with a Draft Hood) or “Induced Draft” (with an Inducer Fan and no Draft Hood).
 - Combustion air can be drawn from outdoors (through vents or ducts), or from indoors utilizing room *volume* (sometimes with vents to an adjacent room/space to provide additional volume).
- These Combustion Air requirements apply only to the *Furnace/Heater* and *Water Heater*. Cooking Appliances and Clothes Dryers are excluded.
- The required amount of combustion air is a function of the total Btu/hour Input rating of the applicable appliance(s) (Furnace/Heater and/or Water Heater) in the room/space/enclosure. The Input rating is stated on the manufacturer’s nameplate. When the nameplate is missing or illegible, use the default Btu/hr values specified in Z-8 below.
- Also refer to “Combustion Air Requirements for Gas Furnaces/Heaters and Water Heaters” (CSD Conventional WIS Appendix D and CSD Mobile WIS Appendix C) for a summary of code requirements, definitions, and a matrix of vent and duct sizes and room volumes required for several common Btu/hour Input ratings.

Y-2 (B) COMBUSTION AIR FROM OUTDOORS**Y-2 (B)-1 Vent Size**

- Combustion air from outdoors is conveyed to the appliance enclosure through vents and/or ducts leading out of the envelope (combustion and ventilation air vents, also called “CVA vents”).
- The required size of a vent is expressed as “net free venting area” (NFVA) in square inches. However, all vents and ducts are required to be screened (*except* ducts terminating in the attic, which may not be screened), and the blocking effect of screens and louvers must be taken into account.
- Because of that blocking effect, the “gross area” of a vent’s screened opening (the actual size in sq. in.) is larger than the “net free” area (NFVA).
- When the NFVA rating is stamped on the vent, it may be used.
- When the NFVA rating is not stamped on the vent, NFVA can be estimated by *multiplying* the gross opening area by a “Reduction Factor” shown in the table below. [(Gross Area) x (Reduction Factor) = NFVA]
- When the required NFVA is known, the gross size of the vent needed to provide it can be determined by *dividing* the NFVA by the Reduction Factor. [(NFVA) ÷ (Reduction Factor) = Gross Area]

SCREEN AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS

1/4" Screen (Hardware Cloth)	1/4" Screen with Metal Louvers	1/4" Screen with Wood Louvers	Insect Screen (Mesh under 1/4")	Insect Screen with Metal Louvers	Insect Screen with Wood Louvers
0.90 (90%)	0.75 (75%)	0.25 (25%)	0.50 (50%)	0.50 (50%)	0.25 (25%)

**Note:* 1/4" Screen is mesh with wires spaced 1/4" apart (“quarter-inch hardware cloth”), which is specified in the CMC (Article 702.3). Mesh with a weave tighter than 1/4" (referred to in the table as “insect screen”) can have wires 1/8" apart, or it can be 1/16" mesh (the insect screen used on doors and windows).

Examples:

- When Gross Area is known: to determine its NFVA, multiply the Gross Area by the Reduction Factor. **(Gross Area) x (Reduction Factor) = NFVA.**
 - Assume a vent with a 5" x 10" opening covered with 1/4" screen (no louvers). 5" x 10" = 50 sq. in. gross opening. 50 sq. in. x **0.90** = 45 sq. in. NFVA.
 - With metal louvers: 50 sq. in. x **0.75** = 37.5 sq. in. NFVA.

2. When the NFVA requirement is known: to determine the gross vent size required, *divide* the NFVA by the applicable "Reduction Factor". **(NFVA) ÷ (Reduction Factor) = Gross Area** needed to provide the required NFVA. Using the example above in reverse...
 - a. To provide 45 sq. in. of NFVA, a 1/4" screen-only vent must have a gross size of 50 sq. in. (45 sq. in. NFVA ÷ 0.90 = 50 sq. in. Gross Area).
 - b. To provide 37.5 sq. in. of NFVA, a vent with metal louvers and 1/4" screen must have a gross size of 50 sq. in. (37.5 sq. in. NFVA ÷ 0.75 = 50 sq. in. Gross Area).

Y-2 (B)-2 Number, Location, and NFVA of Vents

Two vents to outdoors, one Upper and one Lower, are required. (*Note:* There is no longer an exception allowing use of only an upper vent; a lower vent is always required.). Also see "Combustion Air Requirements for Gas Furnaces/Heaters and Water Heaters" (CSD Conventional WIS Appendix D and Mobile WIS Appendix C).

1. Upper and Lower Vent Locations:

- a. One vent located within 12" of the floor, and
- b. One within 12" of the ceiling. (*Note:* Vertical and horizontal ducts may also be used.)
 - Exception: A pre-existing Upper vent located at any height above the Draft Hood opening is acceptable; however, a new Upper vent installed in this program must be located within 12" of the ceiling.

2. NFVA:

- a. Each **vent or vertical duct** must provide 1 sq. in. NFVA for each **4,000 Btu/hr** of combined Input ratings for all applicable appliances drawing combustion air from that room/space (Furnace/Heater and/or Water Heater).
 - *Note:* The lower vent may be a vertical duct from the attic (starting 6" above insulation) that terminates within 12" of the floor. The ends must not be screened, and the duct must comply with UMC Chapter 7 and local code.
- b. When 2 **horizontal ducts** are used, they must each provide 1 sq. in. NFVA for each **2,000 Btu/hr** of combined Input ratings.

Y-2 (C) COMBUSTION AIR FROM INDOORS

Combustion air may be obtained from the room or space in which the appliance is located, rather than from outdoors. The volume of air required (in cubic feet) is a function of the total of Btu/hr Input rating(s) of applicable appliances (Furnace/Heater and/or Water Heater) in the room/space.

Y-2 (C)-1 Room Volume

Room Volume must be at least **50 cu. ft** for each **1,000 Btu/hr** of combined Input ratings for all applicable appliances (Furnace/Heater and/or Water Heater) drawing combustion air from that room.

Y-2 (C)-2 Vents to an Adjacent Space

1. If volume is not adequate, and outside air vents are not appropriate, vents in the wall and/or door may be installed to bring air in from an adjacent room/space.
2. Vents must be 1 sq. in. for each **1,000 Btu/hr** Input (minimum 100 sq. in.) and positioned within 12" of the ceiling and within 12" of the floor.

Y-2 (D) MOBILE HOME WATER HEATER UPPER COMBUSTION AIR VENT

When the Upper vent is created by passing the appliance vent pipe through the center of a larger pipe, adequacy of the area (space) between the outer and inner pipes may be verified by doing the following:

1. Measure the diameter of each pipe.
2. Obtain the "Pipe Area (sq. in.);" for each pipe from the Table on the following page.
3. Subtract the smaller pipe area from the larger one to determine the NFVA between the pipes.
4. Write the answer in CASIF Step I-6 as the Upper "Existing vent NFV sq. in." on Pre-Wx Test line (a).

(See Table on next page.)

Pipe Diameter (in.)	3"	4"	5"	6"	7"	8"	9"	10"
Pipe Area (sq. in.)	7.1	12.6	19.6	28.3	38.5	50.3	63.6	78.5
Pipe Circumference (in.)	9.4	12.6	15.7	18.8	22.0	25.1	28.3	31.4

“Z”—ACTION INSTRUCTIONS

Z-1 CONDITIONS REQUIRING IMMEDIATE SERVICE

1. Examples

The following are examples of *Conditions Requiring Immediate Service*, which must be corrected before infiltration-reduction measures are installed. (These are also referred to as “Hazardous Conditions” in the WIS and in P&P Sections 1.27 & 1.28; however, that term should not be used when speaking with the client.)

- Gas Leaks.
- CO ppm above level requiring service (see Z-6.1), commonly referred to as “High CO”.
- Continuous Roll-Out
- Continuous Spillage—and/or—flue/vent system obstructions causing Spillage.
- Flame Interference and/or physical evidence of a Cracked Heat Exchanger (cracks, holes, warping, metal fatigue, etc.).
- Damaged/disconnected flue/vent pipe—and/or—other condition allowing flue gas to escape.

2. What to Do

- Do not install Infiltration Reduction Measures until all such conditions have been corrected. (See X-6 regarding problems found during Interim Tests and Post-Wx Tests.)
- Turn the appliance with such a condition off at the thermostat.
- Instruct client to not use that appliance until the service has been performed and the condition has been corrected.
- Record the condition in CASIF Section (A).
- Document client notification in (D) or on back of CASIF page 1. When a formal notification form is available, document Condition(s) Requiring Immediate and client instructions on the form, obtain client’s signature, and give a copy to the client.
- Mark the “*Service Required*” box on page 1 when any condition with *Immediate Service Required* (i.e., a “hazardous condition”) has not been corrected before the CASIF is returned to the office.

3. Service and Repairs

- Conditions with *Immediate Service Required* must be corrected by a qualified person, which, in most cases, is a utility Gas Service Representative, an HVAC contractor, or BEAR-certified technician.
- Weatherization crews** do not make adjustments to the gas pressure, air-gas mixture, and other technical adjustments. Crews may make only those repairs for which they are trained and qualified, which may include:
 - Correction of Draft Hood abnormalities (e.g., improperly positioned, double, missing).
 - Vent Pipe repairs (e.g., replacement, minor adjustments, securing joints with screws).

4. Recording Service and Repairs

For Conditions with *Immediate Service Required*, corrections are recorded in CASIF Section (A).

Z-2 OTHER REQUIRED REPAIRS

Required Repairs are conditions that must be corrected but do not require immediate service.

1. Examples of *Required Repairs*

- No Draft Hood or Multiple Draft Hoods (if there is Spillage or High CO, see Z-1).
- Gas Flex with soldered-on fittings (avoid bending/disturbing during CAS testing).

- c. Inadequate Combustion Air NFVA.
- d. Vent Pipe needing Vent Cap or screws in joints.
- e. Delayed Ignition with CO ppm below level requiring service (see Z-6.1).
- f. Pilot defects, such as:
 - Flame size or position improper.
 - IID does not properly light pilot.
 - Thermocouple/pilot generator does not function properly.
- g. Water Heater with both Combustion Chamber Inner Shield and Outer Door missing.
- h. Missing or defective parts, such as the following:
 - Combustion chamber door.
 - Roll-Out Shield (if unit was manufactured with one).
 - Air handler door defective or missing (opening must be temporarily sealed for testing).
- i. A primary gas appliance (e.g. Furnace/Heater, Water Heater, Range/Oven) that will not operate and does not have a Gas Leak or other condition with *Immediate Service Required*.
- j. Gas Range with three or more defective burners, an oven that does not work, or oven door that is broken or does not close. [Note: A Range/Oven may have up to 2 non-functioning burners without repairs being required. See Z-5.2.]
- k. Mobile home with gas cooking has improper/defective gravity or mechanical ventilation (see CSD Mobile Home WIS, Item 7, page 1-13)
- l. Gas Clothes Dryer Moisture Exhaust not exhausted outdoors (or is vented under the house and a functional floor furnace is present).

Exceptions: A Clothes Dryer or secondary appliance (e.g. a second/supplementary Heater, Range or Water Heater) that is defective or will not operate, does not have to be tested or repaired if it is *abandoned*.

- List in (D) as a Recommended Repair.
- See Z-9 regarding Abandoned Appliances.

2. What to do:

- a. Record *Other Required Repairs* in CASIF Section (B).
- b. Inform client, and document client notification in (D) or on back of CASIF page 1. When a formal notification form is available, document *Other Required Repairs* on the form, obtain client's signature, and give a copy to the client.
- c. Arrange for or make repairs in conjunction with weatherization.

3. Service and Repairs:

- a. *Required Repairs* must be performed by a qualified person, which, in most cases, is a utility Gas Service Representative, an HVAC contractor, or BEAR-certified technician.
- b. **Weatherization crews** may make repairs for which they are trained and qualified, which may include the following:
 - Secure a loose water heater draft hood with screws.
 - Replace defective vent system components and install replacement vent cap.
 - Secure single-wall metal flue/vent pipe joints and connections with screws.
 - Correct other minor flue/vent problems.
 - Replace minor hardware, such as water heater burner access doors.
 - Install additional combustion air venting.
 - Install a gas clothes dryer moisture exhaust.

Z-3 GAS LEAKS AND GAS CONNECTORS

1. "Olfactory Test": Sniff with your nose for the odor of leaking gas in the following locations:
 - a. Within 2 feet above **natural gas** valves and fittings.

- b. Within 3 inches below **propane** valves and fittings.

2. Additional Tests:

a. Purpose

- To detect small gas leaks that may not be found with the nose alone.
- Required for persons not fully sensitive to gas odors (Bubble Test recommended).

b. Bubble Test

- Application of a commercial Leak Detection Liquid/Spray (or solution made with liquid dish-washing detergent and water).
- Apply to valves and fittings near and on the appliance.
- Not feasible when valves and fittings cannot be safely accessed, such as in the following situations:
 - Range or Oven is built in.
 - Range is heavy, and moving it is difficult and/or may damage the floor.*
(Spray any valves/fittings that can be reached without moving the unit.)
 - Dryer is built in, or moving it is difficult and/or may damage the floor.*
(Spray any valves/fittings that can be reached without moving the unit.)

*Also, the unit should not be moved if an old-style flex connector with soldered fitting(s) is present (see Z-3.4 below).

c. Mechanized (Instrumented) Test

- Use of an Electronic Leak Detector near valves and fittings.
- May be used when Bubble Test is not feasible.
- *Caution:* Do not use an Electronic Leak Detector *after* applying a Commercial Leak Detection Liquid, because vapors from the liquid can produce a false positive result. If both methods are used, always use the Electronic Leak Detector first.

3. A Gas Leak is a Condition with *Immediate Service Required* (see Z-1).

If a gas leak is found, the following must be done immediately:

- Warn client to not use appliances that could ignite leaking gas.
- Postpone remaining CAS tests that could ignite leaking gas until after the leak is repaired.
- Ask the client to call the utility company Gas Service Dept. (or LP gas dealer) to fix the leak.
- If the odor of leaking gas is strong inside the house:
 - Avoid using light switches, telephone, or flashlight (3-cell or larger) when a strong odor of leaking gas is present (electric sparks can ignite gas fumes).
 - Telephone from outside the house (e.g., on a cell phone or at a neighbor's house).
 - Wait outside for repair service, but do not turn off the gas at the meter. (Gas is most explosive in a mixture of 10% gas and 90% air. Turning off the valve at the gas meter when the concentration is over 10% can allow dilution by air to return the mixture to a more dangerous state.)
- Record gas leaks and repairs in (A).
- Only persons qualified to do so may repair gas leaks (e.g., a utility gas service technician, an appliance repair (BEAR) contractor, an HVAC technician, or a plumbing contractor).

4. Visual Examination for Old-style Flexible Gas Connectors with Soldered Fittings

Until about 1986, uncoated brass flexible gas connectors were made with one or both threaded fittings soldered onto the flex tubing ("butt-soldered" joints). The solder may react with gas and become weakened—causing the soldered joint to break loose when the connector is disturbed, creating a catastrophic gas leak (which can occur when moving a gas range or dryer). When checking for gas leaks in older homes, look for uncoated brass flexible gas connectors with either or both fittings butt-soldered onto the flex tubing. When a gas connector is identified as having soldered fittings:

- Do not bend or otherwise disturb the flex connector or fittings—and do not move the appliance.
- If the flex connector or fitting is leaking gas, shut off the line valve. Do not attempt to tighten the fitting(s).

- c. List the connector as a Required Repair in CASIF Section (B).
- d. The connector must be replaced with a new listed flexible gas connector.
- e. Contact the gas supplier to determine if they have a replacement program (some utilities replace soldered gas connectors at no charge).

[For more information about flexible gas connectors with soldered joints, visit the Consumer Product Safety Commission website at <http://www.cpsc.gov/CPSCPUB/PREREL/PRHTML97/97003.html> or go to their home page at <http://www.cpsc.gov> and search using the topic "flexible gas connectors". There are several CPSC documents available, some with pictures that may be helpful.]

5. Visual Examination for Copper Tubing Used as a Gas Connector

In some older installations, copper tubing was used to bring gas from the line valve to the appliance. Copper reacts with gas, causing deterioration of the metal and sometimes blockage of the line; so copper is no longer used. However, replacement of the copper connector is *not* a Required Repair, unless it is clogged or leaking. When a gas connector is identified as copper tubing:

- a. List the copper connector as a Recommended Repair in CASIF Section (D).
- b. Inform the home owner/manager, and suggest contacting the gas supplier to determine if they offer any assistance in replacing copper gas connectors (some utilities do).

Z-4 FLUE AND VENT DEFECTS

1. **Conditions with *Immediate Service Required*:** A Flue/Vent System with a disconnected joint, Draft Hood defect, obstruction, or any other condition which adversely affects draft or causes combustion products to enter the home is a condition with *Immediate Service Required* (see Z-1).
2. **Improper Terminations**
 - a. Conventional Homes: See CSD Conventional Home WIS, 1-17.
 - b. Mobile Homes: See CSD Mobile Home WIS, page 1-16.
3. **Masonry Fireplace with Gas Appliance:**
 - a. Check for Gas Leaks when a Gas Lighter, a Gas Log, or a Gas Heating Unit ("Gas Fireplace") is present.
 - b. Also perform CO and Draft Test [per CASIF (H)] when a Gas Log or a Gas Heating Unit is used as the *primary* heater.
 - c. When a Gas Log is installed, UMC Section 901.2 requires the fireplace damper to be "permanently blocked open to a sufficient amount to prevent spillage of combustion products into the room."
 - This is commonly done by installing "damper clips" to hold the damper slightly open.
 - The following are *Required Repairs* when a Gas Log is the *primary* heating source:
 - A Damper that is not blocked open (e.g., with a permanently-installed damper clip).
 - A Gas Log with a damper clip in place that does not pass the Visual Draft Test.
4. **Unvented Appliances**
 - a. If a portable unvented heater (kerosene or gas) or a cooking appliance is used to heat the living space, do not install Infiltration Reduction Measures until corrective action is taken (see WAP P&P Sections 1.42 & 1.43).
 - If a portable unvented heater is present, it must first be removed from the home.
 - If the *primary* Furnace/Heater is defective and cannot be used, it must be repaired or replaced (record in CASIF Section (A) or (B) as applicable).
 - b. Client Education:
 - The client must be informed that heating with an unvented source brings CO and other combustion byproducts into the home, which can be unsafe, especially while people are sleeping (see WAP P&P Sections 1.45 and 1.46).
 - Document client education in (D).

Z-5 BURNER ABNORMALITIES

1. Forced Air Units:

- a. If In-Flue or Ambient CO ppm exceeds maximums specified in Z-6.1 and the WIS, see Z-1.
- b. A change in flame pattern and/or color when blower comes on ("flame interference") usually indicates a defective heat exchanger. If detected, and/or if there is visual evidence of a defective heat exchanger, see Z-1.
- c. Delayed Ignition (with a bang or whoosh) and/or Roll-Out, Large Yellow Flames (more than 50% yellow), Soft Lazy Flames, etc., must be repaired by a qualified technician (see Z-2).
 - Note that a decorative fireplace or gas log may be designed to burn with a yellow flame, and that would not be considered abnormal if CO and Draft Test results are satisfactory.

2. Cook Stove/Oven:

- a. The following are *Required Repairs* to be recorded in (B):
 - Three or more top burners do not operate.
 - The oven does not work (cannot be lit with a match).
 - The oven door is broken or does not close properly.
 - b. If a Gas Leak or other condition with *Immediate Service Required* is not present, the following problems may be recorded in (D) as Recommended Repairs. These conditions do not prevent installation of infiltration-reduction measures:
 - A pilot does not work, but the burner can be lit with a match, it burns properly, and CO is OK.
 - A burner knob is frozen or for any reason 1 or 2 burners will not light, even with a match.
 - The oven operates but has a separate broiler burner which does not work.
 - c. See WIS and WAP P&P Section 1 regarding appliance repair and replacement. See Z-9 and WAP P&P Sections 1.11-1.17 and 1.72-1.74 regarding abandoning appliances.
3. **Aldehydes:** Aldehydes have an acrid odor and irritate the nose and throat. Aldehyde odor is a sign of improper burner operation and creation of CO—and a warning to look for defects and high CO.

Z-6 CO TESTS

1. Appliance CO:

- a. *Pre-Wx Test* CO maximum is **100 ppm** for all tests. If CO exceeds 100 ppm before or after weatherization, the appliance must be serviced and declared safe by a qualified technician before Infiltration Reduction Measures are installed.
- b. *Post-Service* CO limits are **225 ppm** for Ovens and Broilers, and **100 ppm** for all other appliances. If Post-Wx Test CO exceeds these limits, see X-6.4.

2. Living Space Ambient CO:

- a. Follow procedures in Conventional WIS **Appendix H** (and Mobile WIS Appendix E).
- b. Establish "**Conditions for Initial Living Space Ambient CO Test**" listed above Section (F) on CASIF page 2.

3. Initial Living Space Ambient CO (step F-1):

- a. "Zero" the CO Analyzer *outdoors* in a location protected from CO sources (see WIS page H-1). This is the "**outdoor**" reading. [Note: The Analyzer can be considered zeroed with a readout bounce of up to ± 3 ppm (-003 to $+003$).]
- b. Bring the CO Analyzer inside to an open area in the main body of the living space (usually the living room or living/dining combination area).
- c. Staying at least 10 feet from gas appliances and FAU registers, take an indoor CO reading.
- d. The *difference* between the outdoor reading (000 ± 3 ppm) and *this indoor* reading is the **Initial Living Space Ambient CO**. *Examples:*
 - If the CO Analyzer reading is 002 outdoors and 008 indoors, the *difference* is 6 ppm CO ($008 - 002 = 006$), so "6 ppm" is recorded for the **Initial Living Space Ambient CO**.

- If the outdoor reading is –002 and the indoor reading is 004, the *difference* is still 6 ppm CO. (From –002 to 000 is 2 ppm. From 000 to 004 is 4 ppm.) The *overall* change is 2 + 4, which totals 6. So again “6 ppm” is recorded for the *Initial Living Space Ambient CO*.

- e. When *Initial Living Space Ambient CO* is **10 ppm** or higher, determine whether heavy smoking and/or use of an Unvented Appliance is likely to be the cause. Temporarily eliminate such possible causes, ventilate the house for 15 minutes or more, and retest.

4. **Second Living Space Ambient CO (step F-3):**

- a. Leave Doors and Windows as they are, and keep all Exhaust Devices off.
- b. Turn on *all gas Furnaces/Heaters*, and operate them for 5 minutes.
- c. Take another CO reading at the *same* indoor location as before. The *difference* between *this indoor* reading and the *outdoor* reading is the **Second Living Space Ambient CO**. If it is **10 ppm** or higher, corrective action is required (see WIS page 1-5).

5. Appliance Ambient CO (step F-4; see Conventional WIS page H-3):

- a. Immediately following step F-3, check each Furnace/Heater for the presence of CO. Sample inside the nearest supply register of an FAU or above the heat exchanger of a non-ducted unit. (See Conventional WIS pages 1-5 and H-3.)
- b. Compare this *Appliance CO* reading with the *Second Living Space Ambient CO* reading. The CO readout ppm could stay the same, decrease, or increase. Record the *amount of change* in ppm as the **Appliance Ambient CO**.
- c. No change or a decrease is OK, but *any increase* is considered a condition with *Immediate Service Required*—which could be caused by a cracked heat exchanger. (See Z-1 & WIS page 1-5.)

Note: Before turning off a Monoxor, allow it to drop to “zero” (especially important after high readings).

Z-7 DRAFT AND SPILLAGE TESTS

1. “Mechanized” (Instrumented) Draft Test:

- a. Perform on all Natural Draft units and on Induced Draft units when test hole is feasible (see X-8).
- b. Drill a test hole as prescribed in X-8.
- c. Insert the tester probe (i.e., Draft Gauge, CO Analyzer, Manometer) to the center of Vent Pipe.
- d. To “Pass,” the pressure must be *negative*, and the reading must be at least as negative (low) as the applicable pressure shown in Y-1. (Also see WIS pages 1-8, 1-9 and 1-10.)
- e. A reading that is not negative (low) enough is a condition with *Immediate Service Required* (Z-1).

2. “Visual” Draft Test (Using Smoke):

- a. Perform on all Natural Draft units.
- b. Use a smoke “puffer”, incense stick, or extinguished match (no flames and no cigarettes). [When using a match (preferably long wooden type): light it 2 feet away from the appliance, extinguish the flame, and then place it near the Draft Hood opening.]
- c. Place smoke along the *entire* lead (top) edge of the Draft Hood opening.
- d. If the smoke is consistently drawn inward, it is a “Pass”. If not, or if smoke flows away from the Draft Hood, it is a condition with *Immediate Service Required* (see Z-1).

3. “Tactile” Test for Spillage:

- a. Perform in conjunction with the Mechanized Draft Test(s) on all Natural Draft units.
- b. Check for Spillage by moving the back of your hand along the *entire* Draft Hood opening.
- c. Spillage will feel warm and *moist* on your skin (because water is product of combustion).
- d. Spillage that is continuous (not caused momentarily by gusts of wind) is a condition with *Immediate Service Required* (see Z-1).

Z-8 DEFAULT BTU/HOUR INPUT RATINGS

When the Btu/hr Input Rating cannot be obtained from the manufacturer’s nameplate, the following “default” values may be used.

1. Combustion Air and MVR calculations

a. **Forced Air Furnaces:** 25,000 Btu/hr per burner.

[Note: When the unit is in an attic, adequate attic ventilation is required.]

b. **Wall Furnaces:**

- Single Sided: 35,000 Btu/hr.
- Double Sided with Two Burners: 60,000 Btu/hr.

c. **Floor Furnaces:**

[Note: Adequate crawl space cross-ventilation is required.]

- Standard: 30,000 Btu/hr (usually 22" wide).
- Large: 60,000 Btu/hr (usually wider than a single floor-joist bay).

d. **Free-Standing Heaters:**

- Small: 25,000 Btu/hr.
- Standard: 50,000 (over 24" wide & 12" deep).

e. **Water Heater:** 1,000 Btu/hr per gallon.

2. MVR calculations: The following appliances do not require Combustion Air calculations; however, the default values are included for MVR calculations:

- a. Cook Top: 10,000 Btu/hr per burner.
- b. Ovens: 20,000 Btu/hr per burner.
- c. Clothes Dryers: 25,000 Btu/hr.

Z-9 ABANDONED APPLIANCES

For detailed policies regarding abandoning appliances, see P&P Sections 1.11–1.17 and 1.72–1.74. The following are brief guidelines (also see Z-5.2 above).

1. An abandoned appliance:
 - a. does not require CAS testing.
 - b. does not prevent installation of Infiltration Reduction Measures.
2. An appliance is considered abandoned only if:
 - a. the Gas Flex is removed, and
 - b. the Gas Line Valve is capped (or the Valve is removed and the Gas Line is capped).
3. When a Cook Top or Oven burner is abandoned, the Burner Valve must be capped when possible.
4. The client must give written permission before an appliance is abandoned.
5. An appliance or burner may be abandoned only by a qualified person.
6. Any appliance or burner either abandoned or found abandoned must be recorded in (D).

Z-10 COMPLETE TESTING PREVENTED BY INACCESSIBILITY (Also see X-9.5.)

When inaccessibility prevents one or more CAS tests: (a) perform all feasible tests, and (b) attempt to determine whether a hazardous condition is present. *Example:* a gas Floor Furnace cannot be reached for inspection or Draft and CO tests, because crawling under the house is impossible. Do the following:

1. Attempt to determine if an unsafe condition exists by doing the following types of checks:
 - a. Sniff for Gas Leaks and measure Ambient CO in the atmosphere above the Floor Furnace.
 - b. Sniff for gas odor under the house.
 - c. Reach into the crawl space as far as possible with a Monoxor "probe extension" and measure CO.
 - d. From the access or a foundation vent, attempt to visually inspect the vent pipe, draft hood, etc.
2. If there is no evidence of gas odor, ambient CO, or vent defects, assume repairs are not required; however, do not install Infiltration Reduction Measures unless allowed by the WAP P&P.
3. If gas odor or ambient CO or hazardous vent defect is found, the appliance is unsafe and correction is a "Health or Safety Hazard Repair or Replacement" Priority Measure.